Construction Challenges and Recent SVC Project Experience

“Building an SVC on Rock”

ATC’s Benson Lake SVC Project
Presenters

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Todays Topics

• Introduction to ATC
• Benson Lake SVC project background
• Project Contract and Design
• Project Construction
• Questions
Introducing ATC

- Began in 2001
- First multi-state, transmission only utility in U.S.
- Assets > $4 billion
- 9,500+ miles of transmission line
- 500+ substations
National leader in building transmission

2,400+ miles of transmission line upgraded or built

170+ substations
Built or improved
Need for Voltage support

• May 10, 2011 West & Central UP Blackout
  • Planned outage of the 345-kV circuit
  • Split system configuration
    • Eastern UP (Pre- Mackinac HVDC)
  • 93 kA Lightning strike caused fault on double circuit 138-kV lines
  • Remaining 138-kV & 69-kV ties tripped within ~2.5 sec to form an island
  • My personal experience during the outage
May 10, 2011 West & Central UP Blackout

- Shield wire received a direct stroke of 93 kA
- Poor grounding causes tower to elevate in voltage
- Results in insulation flash-over and faults the middle phase of both circuits
  - Arresters had been installed on the bottom phase of both lines
May 10, 2011 West & Central UP Blackout
Bay Lake Projects

New North Appleton to Morgan transmission lines

New Holmes to Old Mead Road line and Benson Lake SVC
Static VAr Compensator (SVC)

- Static VAr Compensator is a set of electrical devices for providing fast-acting reactive power on high-voltage electricity transmission networks. SVCs are part of the Flexible AC transmission system device family, regulating voltage, power factor, harmonics and stabilizing the system.
SVC Development & Siting

• Amberg Substation preferred location from power flow perspective
  • Physical limitations

• Other sites evaluated but ruled out
  • Holmes Substation
  • Former distribution station
  • New network substation near Amberg Substation

• Decision made to site new SVC adjacent to Amberg Substation
  • On ATC property
  • Radial 138kV line back to Amberg Substation
  • Named “Benson Lake SVC”
Benson Lake SVC Siting
Benson Lake SVC Siting
Benson Lake SVC Siting

• Bay Lake Certificate of Public Convenience and Necessity (CPCN) Application filed May 2014
  • Two Benson Lake alternatives proposed
    • ‘North’ alternative
    • ‘South’ alternative

• Public Service Commission of Wisconsin (PSCW) Order received May 2015
  • ‘North’ alternative Ordered due to lesser impact on forested wetlands
Benson Lake SVC Contract

• EPC contract to SVC manufacturer for SVC
  • ATC responsible for design and construction of stormwater facilities and all grading/site work
    • AECOM perform design via subcontract with ATC Alliance partner Black & Veatch

• ATC contracted with Black and Veatch
  • Perform system studies
  • Create SVC functional specification
  • Act as Owners Engineer

• October 2014: RFP submitted to 3 bidders

• September 2015: EPC Contract awarded to ABB
  • In-Service date of June 30, 2017
Benson Lake SVC Site Design

- Design Challenges
  - Rock
  - Existing 138kV circuit relocation
  - Sound mitigation - residences to the North
  - Access road
  - Detention basin
  - Retaining walls
  - Minimize wetland impacts
  - Overexcavation
Benson Lake SVC Interfaces

• Protection of 138kV radial line
  • 411L CD / 311L CD over dedicated fiber

• RTU / Communications interface with ABB MACH2 control system

• Security

• Grounding

• Fiber pathways

• Auxillary AC station service sources
Benson Lake SVC - Ratings

• Rated for 150 Mvar capacitive and 75 Mvar inductive

• 175 Mvar Thyristor Controlled Reactor (TCR)

• 50 Mvar Thyristor Switched Capacitor (TSC)

• 100 Mvar filters: 3rd, 5th, 7th, and 17th/High Pass

• Rated for continuous operation between 0.90 and 1.1 pu voltage on the 138-kV system
Site Layout
Thyristors

TCR Valve

TSC Valve
Cooling System

- Propylene Glycol
TCR (Thyristor Controlled Reactor)
TSC (Thyristor Switched Capacitor)
Filter Banks
SVC Transformer
Construction Milestones

• February 2016: Tree Clearing
  • Northern Long-Eared bat restrictions

• August 2016: US Army Corps of Engineers (USACOE) wetland permit received, ATC begins site work

• October 2016: ATC complete rough grading of site
  • Site turned over to ABB
Blasting the Rock
Blasting the Rock
Blasting the rock

• Some Details:
  • 32,000+ cubic feet of rock blasted
  • 54,500+ ton of granite reduced to rubble
  • Over excavated to 3 feet below rough grade
  • Backfilled with 44,500 cubic yards of fill
Benson Lake SVC

February 9, 2017

March 9, 2017
Benson Lake SVC

April 7, 2017

May 19, 2017
Benson Lake SVC

• Commissioning Dates
  • Cold Commissioning: Started approximately March 27, 2017
  • Hot Commissioning: Started approximately April 24, 2017 and concluded with transmission testing May 12.

• Commercial as of June 30, 2017
Thank you!
Questions?